Physical Activity, Sensation Seeking, and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study

Martin-Diener, Eva ; Foster, Simon ; Mohler-Kuo, Meichun ; Martin, Brian W

DOI: https://doi.org/10.1123/jpah.2015-0602

Section: Original Research

Article Title: Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study

Authors: Eva Martin-Diener, Simon Foster, Meichun Mohler-Kuo, and Brian W. Martin

Affiliations: Epidemiology, Biostatistics and Prevention Institute, University of Zurich, Zurich, Switzerland.

Running Head: Physical activity and injuries in young men

Journal: *Journal of Physical Activity & Health*

Acceptance Date: April 25, 2016

DOI: http://dx.doi.org/10.1123/jpah.2015-0602

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Title page

Physical activity, sensation seeking and aggression as injury risk factors in young Swiss men: a population-based cohort study

Eva Martin-Diener[1], Simon Foster[1], Meichun Mohler-Kuo[1], Brian W. Martin[1]

Affiliations

[1] Epidemiology, Biostatistics and Prevention Institute, University of Zurich, Zurich, Switzerland

Corresponding author

Eva Martin-Diener

Epidemiology, Biostatistics and Prevention Institute

University of Zurich

Hirschengraben 84

CH-8001 Zurich

Switzerland

Tel +41 44 634 50 01

Fax +41 44 634 51 85

Email eva.martin@ifspm.uzh.ch

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Abstract

Background: To investigate the relationships between physical activity (PA), sports participation as well as sensation seeking or aggression and injury risk in young men. **Methods:** A representative cohort study was conducted with 4686 conscripts for the Swiss army. Risk factors assessed at baseline were PA, the frequency of sports participation, sensation seeking and aggression. The number of injuries during the past 12 months was reported 16 months after baseline. Exposure to moderate-to-vigorous physical activity (MVPA) was estimated based on baseline PA. **Results:** 48.5% reported at least one injury for the past 12 months. After accounting for exposure to MVPA, the most inactive individuals (reference group) had the highest injury risk and those with high levels of PA and weekly sports participation the lowest (Poisson regression analysis: IRR=0.14 [0.12-0.16]). Independent of activity level, sensation seeking increased cumulative injury incidence significantly (Logistic regression analysis (injured vs. not injured): OR=1.29 [1.02-1.63]) and incidence rates marginally. Aggression was marginally associated only with cumulative injury incidence and only in those participating in daily sports. **Conclusions:** When accounting for exposure to PA, being inactive is a strong injury risk factor in young men, while the roles of the personality variables are less clear.

Key words: exercise, behavioural symptoms, wounds and injuries, epidemiology

Word count abstract: 198

Word count manuscript (everything without title page and abstract): 4955

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Introduction

Physical activity (PA) is beneficial for many health outcomes and physical inactivity has been recognized as a major public health concern.[1] However, from a public health perspective there are also a few adverse effects of PA[2] such as the risk of injuries.[3] Particularly young men are prone to suffer from injuries: In Switzerland, it can be expected that every year some 25% of young men experience at least one injury that has to be medically treated, and up to half of those injuries occur in sports.[4,5] From a PA and sports promotion as well as from an injury prevention policy perspective, it would be important to know how levels of PA or sports participation and injury risk are related, i.e. to what extent they are injury risk factors. It is plausible that in a group of active individuals the proportion of those sustaining activity-related injuries is higher than among their inactive counterparts. The occurrence of activity-related injuries has indeed been shown to be positively associated with the weekly duration of PA or with fitness levels.[6] Carlson et al.[7] also found that active individuals had a higher risk of activity-related injuries than inactive individuals, but their risk for a non-activity-related injury was lower, resulting overall in no association between PA level and any injury. For the comparison of injury risks in different activity groups it would be appropriate to not only use proportions of injured individuals, but also injury incidence rates accounting for exposure to PA. To our knowledge, there are no such population-based studies in adults. In children, one study so far found that the least active group had the highest injury risk after accounting for exposure.[8]

In the context of PA, sports participation and injury risk factors, psychological characteristics such as sensation seeking or aggression may also be of interest, particularly in young men. Regarding sensation seeking, men score generally higher than women,[9] and young men score higher than older adults, while at the same time they have a lower level of impulse control. In fact, this so-called "window of vulnerability"[10,11] has been found to be opened from about 12-13 up to 24-25 years of age in men, whereas for women, this window is more limited.[11] Additionally, similar peaks of aggression have been found in young men,[12] and sensation seeking and aggression are positively correlated.[13] It is plausible, that these two personality characteristics could be related to injury risk. Sensation seeking has been shown to be an injury risk factor independent of alcohol consumption in a population-based

study,[14] but not in emergency department patients.[15] Aggression has mainly been investigated in specific sports disciplines.[16] Both personality variables have not been explored in the context of PA and sports on the population level.

The aim of the present study was thus to investigate the associations of PA or sports participation as well as sensation seeking and aggression with overall injury risk in young men. We hypothesized that lower levels of PA are associated with increased injury risk when exposure to PA is taken into account and that high levels of sports participation, sensation seeking and aggression are related to increased injury risk. In addition we explored whether the personality variables modified the effects of PA and sports participation. Specifically, we explored whether the impact of sport and PA on injury risk was stronger if people were in addition highly sensation seeking or highly aggressive.

Methods

Recruitment and participants

Data from the cohort study on substance use risk factors (C-SURF) were analyzed.[17] Participants were recruited from three of six national military recruitment centers, covering 21 of 26 Swiss cantons. Military training is mandatory in Switzerland, thus all young men have to participate in the subscription procedure. Therefore, our recruitment strategy provided access to all young men of a one-year age cohort from the participating cantons. After enrollment at the centers the study was conducted completely independent of the army. Questionnaires were sent to the participants' private addresses to be completed there. Participants were informed that the data would not be shared with third parties, including the army. Baseline data were collected between September 2010 and March 2012 and follow-up data between January 2012 and April 2013. Mean follow-up duration was 16 months. The study was approved by the Lausanne University Medical School's Clinical Research Ethics Committee (Protocol No. 15/07).

A total of 13,245 male conscripts were invited to participate in the study; 7,563 gave written informed consent, 5990 completed the baseline and 5,223 also the follow-up questionnaire. Detailed analyses indicated only small differences between consenter and non-consenters[18] and between responders and non-responders [17]. Observations with missing values for the variables of interest were

dropped. The final sample for these analyses comprised 4686 individuals (89.7% of follow-up responders).

Exposures

Baseline data were used for all injury risk factors except age and highest achieved education. For the latter follow-up data were used because a relevant number of the participants finished their professional training or school only during the follow-up period. All participants answered questions regarding their PA as well as a question regarding their sports participation: PA was assessed with the International Physical Activity Questionnaire (IPAQ-short); low, moderate and high levels of PA were defined using a standard protocol [19]. These three activity levels and five levels of sports participation (drawn from a single categorical question asking the frequency of participation in sports, athletics or exercise) were then used to define an aggregated indicator "PA and sports". Details for the definition of categories are given in figure 1. The following five mutually exclusive categories were defined: "low PA", "moderate PA", "high PA and little sports", "high PA and weekly sports", "daily sports". Sensation seeking was assessed via the validated Brief Sensation Seeking Scale (BSSS; Cronbach's α=0.81, range=1-5)[20]. The personality trait of "aggression/hostility" was assessed via the validated shortened version of the Zuckerman-Kuhlman Personality Scale (ZKPQ; Cronbach's α=0.62, range=0-10).[21]

Covariates

The two remaining subscales of the ZKPQ, "sociability" and "neuroticism/anxiety", were treated as covariates in the present analyses (Cronbach's α=0.66 and 0.72, respectively, range=0-10 for both variables). The following variables were also used as co-variates: age (two groups, divided at the median); language region (German-speaking; French-speaking); highest educational level (mandatory school; secondary II – vocational; secondary II – higher school; tertiary); body mass index (BMI, in kg/m^2) based on self-reported height and weight (underweight [BMI<18.5], normal weight [BMI 18.5 to <25], overweight [BMI 25 to <30], obese [BMI>30]); risky single occasion drinking (RSOD) (yes [≥6 standard drinks on a single occasion at least monthly]; no)[22] cannabis use

disorder, based on the Cannabis Use Disorder Identification Test (CUDIT) (yes [score of 8 and above]; no);[23] previous injury or accident (yes [at least on injury or accident in the 12 months preceding the baseline assessment]; no).

Outcome variables

Injury data were drawn from the follow-up questionnaire. To determine whether a participant had been injured or not during the past 12 months the following question was used: "How often during the past 12 months have you experienced an accident or injury?". Possible answers were "never", "1-2 times", "3-5 times", "6-9 times", "10 times or more often". To determine the total number of injuries for the calculation of rates, conservative estimates were used, i.e.1 injury for the answer "1-2 times", 3 injuries for the answer "3-5 times" etc.

To assess exposure to PA, a standard protocol for IPAQ-short was used to calculate mean minutes of moderate to vigorous physical activity (MVPA) per day, reported for the preceding week at baseline.[19] Since injuries that had occurred during 12 months were reported, total exposure to PA during the entire follow-up period was estimated by multiplying the mean daily exposure by 365.

Statistical analyses

For descriptive analyses, cumulative injury incidences (CII) and injury incidence rates (IIR, with 95% confidence intervals) were calculated for different subgroups. CII was defined as the percentage of the population that reported at least one injury in the past 12 months, IIR are expressed as the number of injuries per 1000 hrs of exposure to MVPA. We used the same analysis strategy for both CII and IIR. First, we assessed the bivariate relationships between injury risk and risk factors and then calculated the fully adjusted model containing all injury risk factors and covariates. Then we independently examined interaction effects between physical activity/sports and the personality variables of interest. Specifically, we calculated a separate model for sensation seeking and aggression. For both calculations we used the fully adjusted model described above and added the four interaction terms between each of the activity categories and the personality variable sensation seeking or aggression, respectively and added the corresponding interaction. The interactions in both

models were built following the conventional approach for interactions between a categorical factor and a continuous variable [24]. Specifically, each dummy-variable related to the 'PA and Sports'-factor was multiplied with the respective personality variable, resulting in four interaction terms in each model..We used logistic regression for modeling the CII and Poisson regression with the logarithm of exposure to MVPA as offset variable for modeling IIR.

For descriptive analyses the personality variables (i.e. sensation seeking, aggression, sociability, anxiety) were trichotomized. In regression analyses, these variables were entered as continuous variables and centered around their means.

Results

The characteristics of the study population are described in table 1. Mean age at baseline was 20.0 (± 1.20) and at follow-up 21.3 (± 1.23) years. Because the young men were generally still in educational training, only 5.1% reported a tertiary degree.

CII and IIR in different subgroups are reported in table 1. Overall, 48.5% of the study participants reported at least one injury for the 12 months preceding the follow-up interview, 40.9% one to two, 6.6% three to five and 1.0% more than five. IIR in the total study population was 0.83 injuries per 1000 hrs of MVPA. Regarding levels of physical activity and sports, IIR was highest in the least active group and lowest in those with high levels of activity and weekly sports participation. . Both CII and IIR seemed to increase with increasing levels of sensation seeking and aggression, respectively.

Table 2 reports the results of the bivariate und multivariate logistic regression and Poisson regression analyses that investigated main effects alone. In the multivariate logistic model (modeling cumulative incidences), "daily sports" and "high PA and little sports" were associated with increased injury risk, but not "high PA and weekly sports". Sensation seeking was clearly associated with increased injury risk and aggression was marginally associated. In the multivariate Poisson model (accounting for exposure to MVPA), injury risk was remarkably higher in the most inactive group than in all other groups. The lowest risk was observed in those with high levels of PA and weekly sports activities; compared to them, injury risk in the group with daily sports was increased

($p<0.0001$). The incidence rate was marginally associated with sensation seeking but not with aggression.

Interactions between physical activity and sports behavior and the personality variables were tested in two separate models, one for sensation seeking and one for aggression (table 3). We found no evidence for interaction effects, except for a marginally significant trend in the aggression-by-daily sports interaction: aggression was associated with a higher CII among those engaging in daily sport, but not in others. This trend was not present, however, for the incidence rates.

As a sensitivity analysis we calculated all the models presented above while additionally including the current status of military service as an explanatory variable. 28.2% of all young men presenting at conscription were not eligible for army training and 10.9% chose civil service as the alternative. The remaining 60.8% of the study participants reported at follow-up that they had already finished their basic training (32.8%), terminated prematurely (4.2%), not yet started (15.2%) or were currently in service (8.6%).The relationships reported in tables 2 and 3 above were not altered by including the status of military service (data not shown).

Discussion

Based on a large population-based representative sample, we examined the role of PA, sports participation and personality variables as risk factors for total injuries in young men in Switzerland. When accounting for exposure to PA, a low level of PA was associated with increased injury risk. Furthermore, the injury incidence rate was higher in those who participated in daily sports, compared to those who were active in sports about once a week. Sensation seeking was a risk factor independent of the level PA and sports, while aggression increased cumulative incidence marginally in those with daily sports participation, but not incidence rates.

Assessment methods and definitions vary widely between studies, thus allowing comparisons only to a limited extent. Our CII of 48.5% included all types and contexts of injuries and also events that had not required medical treatment. As expected, injury incidence was thus higher than in other studies with more restricted injury definitions. According to Swiss surveillance data, a CII of 25% for medically treated injuries has to be expected in young men[4,5] and in a British study, the respective

number was 27%.[25] Other population based studies found a CII of 26% for activity-related injuries among 15-39 year olds who participated in sport or active recreation, or of 31% for all musculoskeletal injuries in 20-40 year olds.[6] Our IIR was 0.83 injuries/1000 hrs of MVPA for total injuries; other studies in adults are not available for comparisons. In a study in 9-12 year old children IIR for activity-related injuries was 0.57 injuries/1000 hrs of MVPA among boys.[8]

Population-based studies in adolescents and adults showed that frequent sports participation increased CII.[25-27] It is remarkable that in our study not only those with daily but also those with only occasional sports participation had an increased overall injury risk whereas no increased risk was found in those with weekly sports participation. A possible explanation for this finding could be that individuals who participated in sports only occasionally were not prepared well enough for those few episodes. Regarding overall PA, there are only a few population-based studies that explored its role as an injury risk factor. In a study from Thailand, the weekly frequency of exercise was not associated with overall injury risk[28] while in a US study, long duration of PA increased the risk of activity-related injuries.[6] These findings are in line with another US study, showing that active individuals had more activity-related and inactive individuals had more non-activity-related injuries, resulting overall in no association between activity level and injury risk.[7] Also in our study, it seemed to be the sports and less the PA component that contributed to overall injury risk. However, when exposure to PA was taken into account, we found that the least active group clearly had the highest injury risk. To our knowledge, there are no other studies in adults that assessed the role of overall PA and sports participation as injury risk factor while accounting for exposure. There are, however, a few studies in youth. In adolescents, also the most inactive group had the highest injury risk,[8] while in another study in children there was no difference in injury risk between groups with different levels of PA.[29]

We found that sensation seeking was an injury risk factor independent of level of PA while aggression was only a marginal risk factor in those who participated in sports daily. These associations were independent of risky alcohol consumption. No other population-based studies have explored the roles of these two personality variables as injury risk factors in the context of PA and sports. In a population-based study on alcohol consumption as an injury risk factor, sensation seeking

has previously been shown to be an independent risk factor as well, showing no interaction with alcohol consumption,[14] while in an emergency department based study only alcohol consumption but not sensation seeking emerged as a risk factor.[15] Regarding aggression, the research focus has been on specific sports such as ice hockey,[16] where aggressive behavior directly leads to injuries.

This study has several strengths. We had a large sample of a specific population group, namely male emerging adults. Every young men in the recruitment areas was invited to participate in the study and a specific analysis had shown that there were only small differences between consenters and non-consenters, and responders and non-responders, respectively.[17,18] The sample is thus representative of young Swiss men. With the prospective nature of the study, risk factors and injury outcomes were assessed in the correct temporal order and reverse causality can basically be excluded. Since participants had been recruited for a study on substance use, detailed information on other potential injury risk factors was available which could be included as covariates in the models.

The main limitations of the study are the crude measures, mainly for injuries. Since we had no information on the context of the injuries it was not possible to distinguish between sports-related, activity-related and other injuries. However, it can be assumed that in this population, the majority of injuries occurred during physical activity or sports.[4,5] It is thus unlikely that the associations with risk factors would be substantially different if we had been able to conduct the analysis for activity-related injuries alone. Injuries were assessed retrospectively for a 12-month recall period which is likely to result in an underestimation of injury incidences;[30] furthermore, exposure to PA over 12 months was estimated based on a report on the past seven days. For both limitations regarding assessments it is unlikely that they were differential with respect to exposure to risk factors.

Our results show that in the general population of young men, being physically active does not necessarily increase overall injury risk. Even if exposure is not taken into account, only those who participate in sports either only occasionally or very frequently are at a higher risk. When exposure is taken into account, the least active group has the highest risk. At the same time, within more active groups, occasional and daily sport participation is still associated with a higher risk than weekly participation. Sensation seeking is a trait in this age group of men that has to be dealt with

independently of PA and sports, while aggression seems to be an issue only in frequent sports participation and there probably in specific disciplines. Since this is an observational study we need to be prudent with recommendations for injury prevention. Future population-based research should distinguish at least between activity and non-activity related injuries and assess PA exposures and injury outcomes in intervention studies. Furthermore, settings should be investigated where also women can be included.

Conclusions

In young men, a low level of PA is a strong injury risk factor when exposure to PA is taken into account. Participation in sports either daily or only occasionally is riskier than participating about once a week. Sensation seeking is an injury risk factor independent of PA and sports participation, while aggression only tends to increase cumulative incidence and only in those participating in daily sports.

Acknowledgements

We thank the C-SURF team and especially Charlotte Eidenbenz for the project management and the study coordination. This work was supported by the Swiss National Science Foundation (Grant Number 33CS30_139467). The funding source had no involvement in the research presented in this paper.

References

1. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet.* Jul 21 2012;380(9838):219-229.

2. U.S. Department of Health and Human Services. *Physical Activity Guidelines Advisory Committee Report.* Washington2008.

3. Finch C, Cassell E. The public health impact of injury during sport and active recreation. *J Sci Med Sport.* Dec 2006;9(6):490-497.

4. Swiss council for Accident Prevention. *Statistics on non-occupational accidents and the level of safety in Switzerland, Road traffic, sports, home and leisure.* Bern: bfu;2012.

5. KSUV [Coordination group for the accidents' statistics]. *Unfallstatistik UVG 2013 [accident statistics 2013].* Lucerne: Suva;2013.

6. Hootman JM, Macera CA, Ainsworth BE, Martin M, Addy CL, Blair SN. Association among physical activity level, cardiorespiratory fitness, and risk of musculoskeletal injury. *Am J Epidemiol.* Aug 1 2001;154(3):251-258.

7. Carlson SA, Hootman JM, Powell KE, et al. Self-reported injury and physical activity levels: United States 2000 to 2002. *Ann Epidemiol.* Sep 2006;16(9):712-719.

8. Bloemers F, Collard D, Paw MC, Van Mechelen W, Twisk J, Verhagen E. Physical inactivity is a risk factor for physical activity-related injuries in children. *Br J Sports Med.* Jul 2012;46(9):669-674.

9. Cross CP, Cyrenne DL, Brown GR. Sex differences in sensation-seeking: a meta-analysis. *Sci Rep.* 2013;3:2486.

10. Steinberg L. A dual systems model of adolescent risk-taking. *Dev Psychobiol.* Apr 2010;52(3):216-224.

11. Shulman EP, Harden KP, Chein JM, Steinberg L. Sex Differences in the Developmental Trajectories of Impulse Control and Sensation-Seeking from Early Adolescence to Early Adulthood. *J Youth Adolesc.* Mar 30 2014.

12. Odgers CL, Moffitt TE, Broadbent JM, et al. Female and male antisocial trajectories: from childhood origins to adult outcomes. *Dev Psychopathol.* Spring 2008;20(2):673-716.

13. Wilson LC, Scarpa A. The link between sensation seeking and aggression: a meta-analytic review. *Aggress Behav.* Jan-Feb 2011;37(1):81-90.

14. Cherpitel CJ. Substance use, injury, and risk-taking dispositions in the general population. *Alcohol Clin Exp Res.* Jan 1999;23(1):121-126.

15. Bazargan-Hejazi S, Gaines T, Duan N, Cherpitel CJ. Correlates of injury among ED visits: effects of alcohol, risk perception, impulsivity, and sensation seeking behaviors. *Am J Drug Alcohol Abuse.* 2007;33(1):101-108.

16. Cusimano MD, Nastis S, Zuccaro L. Effectiveness of interventions to reduce aggression and injuries among ice hockey players: a systematic review. *CMAJ.* Jan 8 2013;185(1):E57-69.

17. Studer J, Baggio S, Mohler-Kuo M, et al. Examining non-response bias in substance use research--are late respondents proxies for non-respondents? *Drug Alcohol Depend.* Sep 1 2013;132(1-2):316-323.

18. Studer J, Mohler-Kuo M, Dermota P, et al. Need for informed consent in substance use studies--harm of bias? *J Stud Alcohol Drugs.* Nov 2013;74(6):931-940.

19. IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ). Short and long forms. www.ipaq.ki.se.

20. Hoyle RH, Stephenson MT, Palmgreen P, Lorch EP, Donohew RL. Reliability and validity of a brief measure of sensation seeking. *Personality and Individual Differences.* 2002;32(3):401-414.

21. Aluja A, Rossier J, Garcia LF, Angleitner A, Kuhlman M, Zuckerman M. A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to English, French, German, and Spanish languages. *Personality and Individual Differences.* 2006;41:619-628.

22. Gmel G, Mohler-Kuo M, Dermota P, et al. Religion is good, belief is better: religion, religiosity, and substance use among young Swiss men. *Subst Use Misuse.* Sep 2013;48(12):1085-1098.

23. Adamson SJ, Sellman JD. A prototype screening instrument for cannabis use disorder: the Cannabis Use Disorders Identification Test (CUDIT) in an alcohol-dependent clinical sample. *Drug Alcohol Rev.* Sep 2003;22(3):309-315.

24. Cohen J, Cohen P, West SG, Aiken LS. *Applied multiple regression/correlation analysis for the behavioral sciences. 3. edition ed.* Mahwah: Lawrence Erlbaum Associates; 2003.

25. Sumilo D, Stewart-Brown S. The causes and consequences of injury in students at UK institutes of higher education. *Public Health.* Feb 2006;120(2):125-131.

26. Mattila V, Parkkari J, Kannus P, Rimpela A. Occurrence and risk factors of unintentional injuries among 12- to 18-year-old Finns--a survey of 8219 adolescents. *Eur J Epidemiol.* 2004;19(5):437-444.

27. Plugge E, Stewar-Brown S, Knight M, Fletcher L. Injury morbidity in 18-64-year-olds: impact and risk factors. *J Public Health Med.* Mar 2002;24(1):27-33.

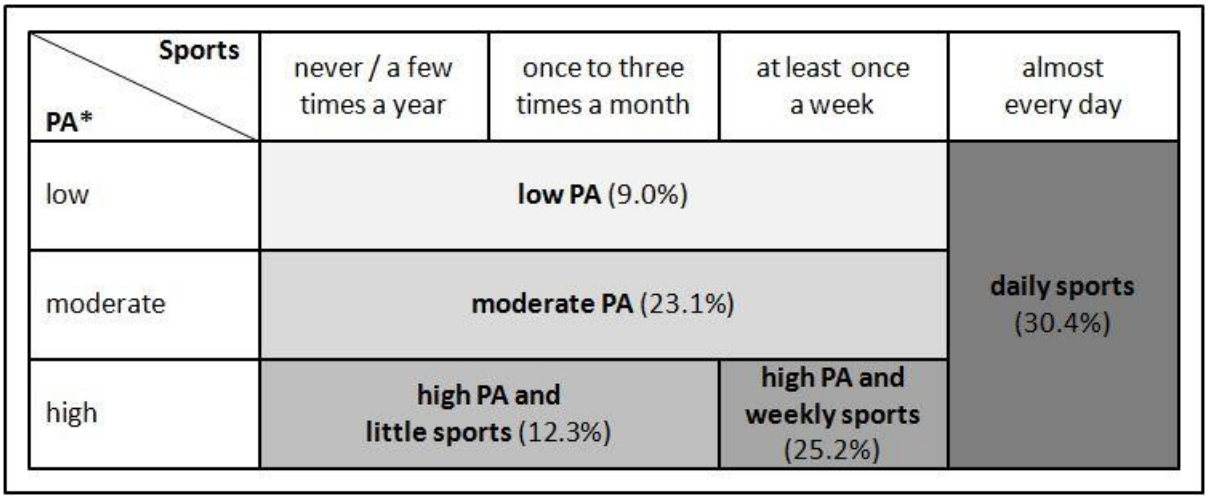
28. Yiengprugsawan V, Stephan K, McClure R, et al. Risk factors for injury in a national cohort of 87,134 Thai adults. *Public Health.* Jan 2012;126(1):33-39.

29. Martin-Diener E, Wanner M, Kriemler S, Martin BW. Associations of objectively assessed levels of physical activity, aerobic fitness and motor coordination with injury risk in school children aged 7-9 years: a cross-sectional study. *BMJ Open.* 2013;3(8).

30. Harel Y, Overpeck MD, Jones DH, et al. The effects of recall on estimating annual nonfatal injury rates for children and adolescents. *Am J Public Health.* Apr 1994;84(4):599-605.

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Figure 1: Definition of the five mutually exclusive categories of the physical activity and sports indicator and distribution of the study population across the five categories



Legend

*high=7 days of any PA and >= 3000 MET-min/week *OR* 3 days of vigorous PA and >= 3000 MET-min/week

moderate=3 or more days of vigorous PA of at least 20 minutes per day *OR* 5 or more days of moderate PA and/or walking of at least 30 minutes per day *OR* 5 or more days of any combination of walking, moderate or vigorous PA achieving a minimum total physical activity of at least 600 MET-minutes/week.

low= Less than moderate or high

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Table 1. Participants' characteristics, cumulative injury incidence (CII) and injury incidence rates (IIR) with 95% confidence intervals (CIs) in subgroups

	N (%)	CII (%)	IIR [95% CI][a]
Overall	4686 (100)	48.5	0.83 [0.80-0.85]
Age			
below median	2347 (50.1)	48.7	0.85 [0.81-0.89]
above median	2339 (49.9)	48.3	0.80 [0.76-0.84]
Education			
Obligatory school	319 (6.8)	49.2	0.89 [0.78-1.01]
Secondary II: vocational	2528 (53.9)	49.0	0.76 [0.72-0.79]
Secondary II: higher school	1599 (34.1)	48.5	0.95 [0.89-1.01]
Tertiary	240 (5.1)	42.1	0.85 [0.71-1.01]
Linguistic region			
German-speaking	2126 (45.4)	45.3	0.71 [0.67-0.75]
French-speaking	2560 (54.6)	51.1	0.93 [0.89-0.98]
BMI			
underweight	163 (3.5)	36.8	0.90 [0.73-1.09]
normal	3589 (76.6)	48.3	0.81 [0.78-0.85]
overweight	757 (16.2)	50.2	0.82 [0.76-0.90]
obese	177 (3.8)	54.2	1.02 [0.86-1.20]
Previous injury or accident			
no	2433 (51.9)	36.5	0.60 [0.56-0.63]
yes	2253 (48.1)	61.3	1.05 [1.00-1.09]
RSOD			
no	2540 (54.2)	44.3	0.76 [0.72-0.80]
yes	2146 (45.8)	53.4	0.90 [0.85-0.94]
Cannabis dependence			
no	4289 (91.5)	47.6	0.80 [0.77-0.83]
yes	397 (8.5)	57.7	1.11 [0.99-1.23]
PA and sports			
Low PA	423 (9.0)	40.4	3.89 [3.39-4.44]
Moderate PA	1080 (23.1)	43.1	1.68 [1.55-1.82]
High PA and little sports	578 (12.3)	52.1	0.64 [0.58-0.70]
High PA and weekly sports	1180 (25.2)	47.2	0.57 [0.52-0.61]
Daily sports	1560 (30.4)	54.5	0.81 [0.76-0.86]

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

	N (%)	CII (%)	IIR [95% CI][a]
Sensation seeking [b]			
low	1731 (36.9)	44.7	0.78 [0.73-0.82]
middle	1586 (33.9)	48.8	0.86 [0.81-0.91]
high	1369 (29.2)	52.8	0.85 [0.80-0.90]
Zuckerman Aggression [b]			
low	2017 (43.0)	45.4	0.78 [0.74-0.82]
moderate	1448 (31.0)	48.9	0.83 [0.78-0.88]
high	1221 (26.1)	53.1	0.89 [0.84-0.95]
Zuckerman Sociability [b]			
low	1859 (39.7)	46.4	0.89 [0.84-0.94]
moderate	1631 (34.8)	49.4	0.83 [0.78-0.87]
high	1196 (25.5)	50.5	0.74 [0.69-0.79]
Zuckerman Anxiety [b]			
low	2463 (52.6)	49.0	0.76 [0.73-0.80]
moderate	810 (17.3)	48.9	0.91 [0.83-0.98]
high	1413 (30.1)	47.4	0.90 [0.84-0.96]

BMI=body mass index; PA=physical activity; RSOD=risky single occasion drinking

[a] Expressed as the number of injuries per 1000 hrs of MVPA

[b] All personality variables were trichotomized for this analysis

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Table 2: Odds ratios (OR), incidence rate ratios (IRR), and 95% confidence intervals (CIs) for injury incidence by risk factor categories

	unadjusted OR [95% CI]	**adjusted OR [95% CI]**	**unadjusted IRR [95% CI]**	**adjusted IRR [95% CI]**
Age [a]	0.97 [0.92-1.01]	0.95 [0.90-1.01]	*0.97 [0.94-1.00]*	**0.94 [0.91-0.97]**
Education				
Obligatory school	1	1	1	1
Secondary II: vocational	0.99 [0.78-1.25]	1.11 [0.86-1.42]	**0.85 [0.75-0.98]**	1.04 [0.90-1.19]
Secondary II: higher school	0.97 [0.76-1.23]	1.05 [0.81-1.35]	1.07 [0.93-1.23]	1.13 [0.98-1.31]
Tertiary	0.75 [0.53-1.05]	0.88 [0.61-1.28]	0.95 [0.77-1.18]	0.99 [0.79-1.24]
Linguistic region				
German-speaking	1	1	1	1
French-speaking	**1.26 [1.12-1.42]**	**1.31 [1.15-1.50]**	**1.32 [1.23-1.42]**	**1.21 [1.12-1.30]**
BMI				
underweight	**0.62 [0.45-0.86]**	0.71 [0.50-1.00]	1.10 [0.89-1.34]	1.02 [0.83-1.25]
normal	1	1	1	1
overweight	1.08 [0.92-1.26]	1.16 [0.98-1.37]	1.01 [0.92-1.11]	**1.11 [1.01-1.22]**
obese	1.27 [0.94-1.72]	**1.40 [1.02-1.93]**	**1.26 [1.05-1.48]**	**1.29 [1.08-1.52]**

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

	unadjusted OR [95% CI]	**adjusted OR [95% CI]**	**unadjusted IRR [95% CI]**	**adjusted IRR [95% CI]**
Previous injury or accident				
no	1	1	1	1
yes	**2.76 [2.45-3.10]**	**2.52 [2.23-2.85]**	**1.75 [1.63-1.88]**	**1.76 [1.64-1.90]**
RSOD				
no	1	1	1	1
yes	**1.44 [1.28-1.61]**	**1.21 [1.06-1.37]**	**1.18 [1.10-1.28]**	**1.13 [1.05-1.21]**
Cannabis dependence				
no	1	1	1	1
yes	**1.50 [1.22-1.85]**	**1.33 [1.06-1.67]**	**1.38 [1.24-1.54]**	**1.22 [1.08-1.37]**
PA and sports				
Low PA	1	1	1	1
Moderate PA	1.11 [0.89-1.40]	1.04 [0.82-1.32]	**0.43 [0.37-0.50]**	**0.40 [0.34-0.47]**
High PA and little sports	**1.60 [1.24-2.07]**	**1.42 [1.09-1.86]**	**0.16 [0.14-0.19]**	**0.15 [0.13-0.18]**
High PA and weekly sports	**1.32 [1.05-1.65]**	1.16 [0.92-1.48]	**0.15 [0.13-0.17]**	**0.14 [0.12-0.16]**
Daily sports	**1.77 [1.42-2.21]**	**1.52 [1.20-1.92]**	**0.21 [0.18-0.24]**	**0.19 [0.16-0.22]**

	unadjusted OR [95% CI]	**adjusted OR [95% CI]**	**unadjusted IRR [95% CI]**	**adjusted IRR [95% CI]**
Sensation seeking [a]	**1.19 [1.12-1.28]**	**1.10 [1.02-1.19]**	**1.05 [1.01-1.10]**	**1.05 [1.00-1.09]**
Zuckerman Aggression [a]	**1.07 [1.04-1.09]**	1.03 [1.00-1.05]	**1.03 [1.01-1.04]**	1.01 [0.99-1.02]
Zuckerman Sociability [a]	*1.03[1.00-1.05]*	0.99 [0.96-1.02]	**0.97 [0.96-0.99]**	**0.98 [0.96-1.00]**
Zuckerman Anxiety [a]	0.99 [0.96-1.02]	0.98 [0.95-1.01]	**1.04 [1.02-1.06]**	1.01 [0.99-1.03]

PA=physical activity; RSOD=risky single occasion drinking

Significant differences are presented in bold (alpha set at 0.05).

[a] included as continuous variable in the models

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

Table 3. Odds ratios (OR), incidence rate ratios (IRR) and 95% confidence intervals (CIs) for injury incidence by risk factor categories, for main effects and interaction effects between sensation seeking and PA/sports, and between aggression and PA/sports

	Sensation seeking x PA/sports		**Aggression x PA/sports**	
	OR [95% CI] [a]	**IRR [95% CI]** [a]	**OR [95% CI]** [b]	**IRR [95% CI]** [b]
Main effects				
PA and sports				
Low PA	1	1	1	1
Moderate PA	1.01 [0.79-1.28]	**0.40 [0.34-0.46]**	1.04 [0.82-1.32]	**0.40 [0.34-0.47]**
High PA and little sports	**1.39 [1.06-1.82]**	**0.15 [0.13-0.17]**	**1.43 [1.10-1.87]**	**0.15 [0.13-0.18]**
High PA and weekly sports	1.13 [0.89-1.44]	**0.13 [0.12-0.16]**	1.17 [0.92-1.48]	**0.14 [0.12-0.16]**
Daily sports	**1.48 [1.16-1.88]**	**0.19 [0.16-0.22]**	**1.52 [1.21-1.93]**	**0.19 [0.16-0.22]**
Personality variable (PV) [c]	**1.29 [1.02-1.63]**	1.13 [0.98-1.31]	0.97 [0.89-1.07]	1.04 [0.98-1.10]
Interaction effects				
Low PA x PV	1	1	1	1
Moderate PA x PV	0.88 [0.67-1.15]	0.99 [0.84-1.17]	1.07 [0.96-1.19]	0.98 [0.91-1.05]
High PA and little sports x PV	0.90 [0.67-1.21]	0.91 [0.76-1.08]	1.01 [0.89-1.13]	0.94 [0.88-1.01]

"Physical Activity, Sensation Seeking and Aggression as Injury Risk Factors in Young Swiss Men: A Population-Based Cohort Study" by Martin-Diener E, Foster S, Mohler-Kuo M, Martin BW
Journal of Physical Activity & Health

	Sensation seeking x PA/sports		**Aggression x PA/sports**	
	OR [95% CI] [a]	**IRR [95% CI]** [a]	**OR [95% CI]** [b]	**IRR [95% CI]** [b]
High PA and weekly sports x PV	0.80 [0.61-1.05]	0.94 [0.79-1.11]	1.02 [0.92-1.13]	0.97 [0.90-1.03]
Daily sports x PV	0.84 [0.65-1.10]	0.88 [0.75-1.03]	1.11 [1.00-1.23]	0.97 [0.91-1.04]

PA=physical activity

Significant differences are presented in bold (alpha set at 0.05).

[a] model controlled for age, education, linguistic region, BMI, previous injury, RSOD, cannabis dependence, , sociability, anxiety, and aggression.

[b] model controlled for age, education, linguistic region, BMI, previous injury, RSOD, cannabis dependence, sociability, anxiety, and sensation seeking.

[c] Personality variable (PV) = sensation seeking or aggression, respectively; included as continuous variables in the models